Proposed Grayson Repowering Project
Unit 9 Separation
Attachment 8 – Electrical Requirements

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A. Introduction

The following sections describe the minimum requirements for the Contractor's supply and installation of the electrical distribution systems necessary to allow the safe, reliable, and efficient operation of the power plant.

The City has provided the electrical design for the scope of work. Please refer to Attachment 6.

This Attachment provides the minimum requirements for supply of electrical equipment, wire and cable, and grounding within the scope of the Specification. It is not the intent to specify completely herein all details of construction. These are minimum requirements and are not inclusive of all requirements that may be contained within accepted national and industry codes and standards, as well as good practice. The material offered by the Contractor shall be manufactured in a manner suitable for long-term operation within a load serving municipal utility.

Each item of equipment and material offered by Contractor shall be suitable for the intended purpose and designed and fabricated in complete accordance with the standards referenced within this Specification.

The installation shall comply with NEC 70 and other relevant codes and standards. The installation shall be carried out so as to minimize the risk of outbreak of fire and consequential damage. Materials used shall not support combustion and shall be fire retardant.

B. Grounding

General

The generation station grounding system shall conform to the relevant sections of IEEE 80 and IEEE 665. The design shall be based on the expected maximum fault current with a duration of 0.5 seconds. After separation of the ground grids, the Contractor will test the Kellogg GIS and Unit 9 ground grids for effectiveness using the Fall-Off Potential method.

Electrical Equipment Grounding

Metal parts of all equipment, other than those forming an electrical circuit, shall be directly connected to the ground grid. In the case of main items of electrical equipment including switchgear, motor control centers, etc., the copper ground bus within the assembly shall be connected to the main station ground grid via at least two No. 4/0 AWG stranded bare conductors from opposite ends of the frame.

A separate instrument signal ground system shall be provided for grounding of instrument signal shields. The instrument signal ground system shall be isolated from the safety ground system with the exception of a single point of connection externally to the main station ground grid using PVC insulated copper conductor.

The frame of draw out equipment shall be connected to the ground bar through a substantial plug type contact.

Power Transformer Grounding

Power transformer tanks shall be grounded to the unit ground grid at a minimum of two places at diagonally opposite corners. All auxiliary equipment attached to the transformer shall be bonded to the tank. All other equipment such as separately mounted coolers, control cubicles, etc., shall be grounded separately to the facility ground grid.

Current and Voltage Transformer Grounding

Current transformers and voltage transformer secondary circuits shall be grounded at one point only through links situated in an accessible position.

Motor Grounding

All motors shall be grounded with a continuous grounding conductor run with the motor leads between the motor and its power source. The grounding conductor shall be connected to the motor frame and terminal box.

All motors rated above 600 Volt shall also be grounded from the motor frame to the ground grid.

C. Wire and Cable

The cable procurement and installation shall include all cables required for the power, control, indication, monitoring and data communications of all plant systems and equipment provided under the Contract Documents. The installation shall be complete with all cable terminations, cable trays, cable tray fittings, conduits, all raceway supports, junction boxes, pull boxes, ferrules, lugs, numbered ferrules, cable markers, clips and all fixings, fittings, brackets, cleats, piping, and accessories. The cables include 480 V and below. Additionally, there will be multi-conductor control cable, instrument and thermocouple cable, fiber optic and data communication type cables.

All power and control cables shall be stranded copper.

General

All 600 V cable shall be TC rated. 600 V power cable shall be multiple conductor with an overall jacket up to No. 1 AWG conductor size. Ground wire shall be supplied with the multiple conductor cables. The conduit and tray system shall be designed to provide equipment grounding per NEC. Single conductor insulated/jacketed conductors shall be used for No. 1/0 AWG and be No. 12.

600 V multi-conductor control cable shall be used for low current levels or for intermittent operation to change the operating status of utilization equipment of the plant auxiliary system.

Low current levels include single-phase ac and dc currents up to 10 amps. CT circuits shall use No. 10 AWG conductors.

Final cable sizing for control applications shall consider voltage drop of the circuit. Multiple pair and multiple triad instrument cable shall be used for low level analog and digital signals at less than 50 V and generally transmitting low level, under 1 amp, information. Instrument cable shall be rated 600 V and thermocouple cable shall be rated 300 V. Minimum conductor size shall be No. 16 AWG. Data communications shall be transmitted across twisted pair or single or multiple-fiber cable. Fiber cable shall be tight or loose buffer and sized according to the usage and installation. Fiber optic patch panels shall be provided wherever fiber cables terminate and shall have 20% spare capacity.

Cable conductors shall be coated or uncoated, Class B stranded, copper in accordance with ICEA. Stranding may be concentric round, compact or compressed round. The insulation of each conductor shall be identified throughout its length either by color or embossed numbers.

Each cable shall be identified by means of indelibly marked identification labels fixed adjacent to the cable gland at each end of the cable. The labels shall be made of material that is resistant to corrosion, moisture, UV radiation and mechanical damage. No intermediate splices will be allowed in any length of cable.

Power Cables

Low (600 V) power cable shall be manufactured in accordance with ICEA standards. Cable shall consist of multiple conductor cable with an overall jacket for conductor sizes up to No. 1 AWG and insulated/jacketed conductors assembled as single conductors or twisted to form triplex conductors for larger conductor sizes. Insulation shall be cross-linked polyethylene (XLPE) or ethylene-propylene rubber (EPR). Cable jacket material shall be polyvinylchloride (PVC) chlorosulfonated polyethylene (Hypalon), Neoprene, or chlorinated polyethylene (CPE),as required to meet the flame requirements and to obtain UL listing for use in tray. Cables installed in tray systems shall be flame retardant in accordance with IEEE 1202 and be UL listed for installation in cable tray. Individual cable jackets are required on the triplex cable and single conductor cables. 3/C and 4/C conductor cable shall not require a jacket on the individual conductors. Grounding wire shall be provided in all multiple conductor power cables.

Fire Resistant Cables

Fire resistant cables, MICC or equivalent cabling shall be provided for areas of high ambient temperature and for essential supplies i.e., smoke and fire detection and alarm system. This cabling shall be either:

a. EPR or XLPE insulated mica glass protected cable having a temperature withstand capability of 3 hours at 750° to ICEA, or

b. Mineral insulated copper sheathed cable with an overall sheath of flame retardant PVC to ICEA.

Control, Instrument, Thermocouple Extension Cables

600 Volt control, instrument and 300 Volt thermocouple extension cable shall be manufactured in accordance with latest applicable ICEA standards.

Conductors for control and instrument cable shall be coated or uncoated copper conductors Class B or C stranded in accordance with ICEA.

Conductors for thermocouple extension cable shall be solid conductors and conform to the error limits established in ANSI MC96.1

Insulation shall be cross-linked polyethylene (XLPE) or ethylene-propylene rubber (EPR) for control cable. PVC insulation is permitted for instrument and thermocouple cable. PVC insulation is permitted for control cable applications requiring 16 AWG conductor size and twisted pairs/triads, typically for PCS applications.

Individual shield consisting of aluminum-Mylar tape shield with a stranded copper drain shall be provided on each pair and triad. Overall shield shall be provided only when expressly required by equipment vendor.

Cable jacket material shall be polyvinylchloride (PVC) chlorosulfonated polyethylene (Hypalon), Neoprene, or chlorinated polyethylene (CPE), as required to meet the flame test requirements and to obtain UL listing for use in tray.

Cables installed in tray systems shall be flame retardant in accordance with IEEE 1202 and be UL listed for installation in tray.

Cable Routing and Segregation

The layout of all cables shall be arranged to have adequate clearance from other services. Cables shall generally be routed to avoid hot or fire-risk areas, and to minimize the risk of damage from any source. Cables shall be separated by service. Cables of different service shall not be run in the same cable tray or conduit.

The control data highway (LAN) route shall be separated from the power cable routes, or proper shielding shall be provided.

All fireproof barriers shall comply with the requirements stated for fire resisting materials and seals detailed below.

Fire Precautions

All apparatus connections and cable installations shall be designed and installed to minimize the risk of fire and any damage which may be caused in the event of fire. Enclosed vertical/horizontal runs of cables shall be provided with fire stops to limit the spread of fire and shall be sealed to prevent "chimney effects".

Wherever cables pass through floors, walls or other partitions, a suitable method of sealing shall be used. This sealing shall consist of one-hour fire resisting materials. All seals shall be vermin proof. Seals in damp areas or areas with water spray fire protection shall be waterproof. The whole installation shall be arranged to prevent the spread of fire, smoke, and fumes through each partition. In areas of high cable density, such as false floors, fire detection equipment shall be provided.

The cabling of the smoke and fire detection and alarm system shall be carried out in high temperature mica glass cables or alternatively mineral insulated cables.

Other equipment required in the event of fire (i.e., fire water valves, etc.) shall also be connected with mineral insulated cables or other fire-resistant cables.

Laying and Terminating of Cables

To avoid the risk of damage, cable pulling shall only take place when the temperature is at or above 32°F and has been at or above this temperature for the previous 24 hours, unless special precautions, approved by the City, have been taken to maintain the cables above this temperature.

Cables shall be marked at each end of the run with a marker consisting of a label attached to the cables with two straps.

Cables shall be neatly laid throughout and in such a manner as to avoid any undue sagging of cables. Where run on trays, the cables shall be securely fastened at intervals of not more than 3 ft. with clips, or saddles. Trays shall be constructed of hot-dipped galvanized steel, galvanized after manufacture or of approved proprietary construction. The installation shall be grounded at regular intervals and shall be made continuous by connections across individual sections of the installation.

Cable shall be installed in accordance with the Ampacity design of the cables, i.e., maintained spaced, one-layer touching, or random filled. Installation method is indicated on pull ticket or on the raceway drawings.

Criteria provided by the cable vendor shall be adhered to avoid cable damage through good raceway design and good cable pulling practice.

The EPC Contractor shall mandrel all underground duct bank conduits with a mandrel of slightly less diameter than the duct, immediately before pulling in the cables. Any cable pulling lubricant used shall have no deleterious effect on the cables nor shall it solidify such that the cables cannot be removed in the future. The ends of conduits shall be sealed after cable installation by an approved fire resistant sealing medium for sealing round cables.

The top layer of cable tray, and all vertical trays, that are installed outside and exposed to sun and rain shall have tray covers.

D. Not Used

E. Panel Internal Wiring

All internal wiring in panels, cubicles and equipment racks shall be carried out using 600 V grade multi-stranded copper wires.

All control wiring shall consist of stranded copper wires of not less than No. 14 AWG cross-section except for wiring associated directly with switchgear control and protection and PT secondary circuits which shall be not less than No. 12 AWG. CTs circuits shall use No. 10 AWG; minimum conductor size Electronic signal wire shall be stranded copper, No. 16 AWG minimum, twisted pair, aluminum-Mylar tape shielded with drain wire and overall jacket.

Wires shall not be spliced between terminal points. Not more than two wires shall be connected to any one terminal. Note: For the purpose of this clause, the 'terminal' is the fixing device on the apparatus and the 'termination' is the device fitted to the wire.

Wiring should be neatly run in wire ways filled not more than 40 percent.

All wires shall have an identification marking at each end numbered in accordance with equipment manufacturer's drawings.

Where separate markers provide the marking, all markers shall be white with permanent black inscriptions, with a finish that minimizes the adhesion of dirt. Sleeve types only shall be used and they shall not slip along the cable, neither shall they be removable without re-terminating.

Where the nominal voltage of any circuit exceeds 125 V, the higher voltage circuit wiring and associated terminal blocks shall be segregated from the 125 V and below wiring and terminal blocks with structurally grounded metal barriers.

Where a cubicle carries apparatus for more than one primary circuit, the wiring for each circuit shall be grouped separately and as far as possible from any common wiring.

F. Terminals and Terminations

For all equipment, wiring shall be terminated using crimped ring-tongue type lugs.

No more than two terminations are permitted on any one terminal block, excluding any special purpose jumpers.

Terminal blocks shall be NEMA rated screw type. Terminal blocks for control wiring 120 V and below shall be rated 300 V and shall be capable of accepting terminal lugs for No. 10 AWG wire and smaller. A provision for spare terminals shall be allowed for possible future modifications. Such a provision shall not be less than 20 percent of the total number of terminals. Terminals shall bear clear, permanent identification as to the number, terminal location, and terminal rows. Terminal blocks shall be grouped according to function. Terminal blocks shall be mounted vertically wherever possible. The preferred minimum height to the bottom of terminals shall be 1.5 ft. above floor level.

G. Controls

Indicating Instruments

Voltage operated instruments shall be suitable for operation from voltage transformers having 120 V secondaries. Voltage operated instruments shall be protected by a fuse on each pole of the circuit placed as close as possible to the voltage transformer terminals.

Control and Indication

Control switches shall be heavy-duty, rotary type, rated 600 volts, 20 amperes. Handle styles shall be large pistol grip for control, round notches for instruments. Switches shall be provided with engraved escutcheons. Control switches shall be GE SB1, or City approved equal. Ammeter and voltmeter switches shall be GE SB1 and shall be "three position and off" type. Lockout relays shall be Electroswitch, Series 24, electrical trip – manual reset type.

Indicating lamps shall be of the long life, solid state, (LED) type. Lamps shall be replaceable from the front.

a. Red:
   - Breaker closed (monitor trip coil and trip circuit)
   - Starter-contactor closed (motor running)

b. Green:
   - Breaker open
   - Starter-contactor open (motor off)

c. Amber
   - Lockout (86) relay coil circuit

Local Control Stations

Local control stations for maintenance and testing shall be provided by the Contractor as required or for equipment that is subject to local control only.

H. Temporary Control Room

The Contractor shall relocate the following equipment from the Boiler Building to the Temporary Control Room:

- Unit 9 Turbine and Balance-of-Plant HMIs
- Unit 9 Servers (CEMS DAHS) and HMIs
- Net Metering PLC and Panels (System)
- Emergency siren controls
- Security system monitors
- Emergency stop switch
- Outfall pH and temperature monitor
- Fire Panel

Equipment shall be set up on metal folding tables or other durable tables provided by the City.

The Contractor will provide two power feeds to the trailer:

- A circuit fed from the UPS Power and Control Enclosure (PACE) to provide power for the Unit 9 controls, communication, and security equipment.
- A circuit fed from normal power to supply the lighting and HVAC systems.

The Contractor will install two Battery Operated Lanterns (BOL) with a minimum 4 hour rating to provide illumination in the control room if normal power is lost. The BOLs will be powered from normal power.

The Contractor will pull new data cables from the Unit 9 Power and Control Enclosure (PACE) to connect to the relocated Unit 9 servers and HMIs.

The Contractor will pull new cable to connect the City relocated phone/communication equipment to the Utility Operations Center (UOC) communications system.

The Contractor will pull new cable to connect the security monitors to the UOC security system.